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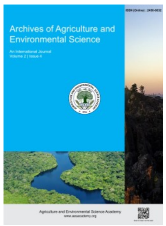

ORIGINAL RESEARCH ARTICLE

Effect of nitrogen and sulphur on the growth and yield of *T. Aman* rice (BRRI Dhan 87)

Md. Belal Hossain[1], Alok Kumar Paul[2], Shekh Tanjina Islam Dola[3*], Md. Shaon Sharif[4], Md. Hasanuzzaman[5], Md. Shahin Hossain[6] and Md. Kamruzzaman[7]

[1]Department of Soil Science, Shere-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
[2]Department of Soil Science, Shere-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
[3]Department of Post Harvest Technology, Patuakhali science and Technology University, Dumki, Patuakhali, Bangladesh
[4]Department of Horticulture, Patuakhali science and Technology University, Dumki, Patuakhali, Bangladesh
[5]Department of Environmental Health and Sanitation, Patuakhali science and Technology University, Dumki, Patuakhali, Bangladesh
[6]Department of Soil Science, Patuakhali science and Technology University, Dumki, Patuakhali, Bangladesh
[7] Faculty of Agriculture, Patuakhali Science and Technology University, Dumki, Patuakhali, Bangladesh
[*]Corresponding author's E-mail: shekhtanjinaislam@gmail.com

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ABSTRACT

Efficient use of nitrogen (N) and sulphur (S) is crucial for enhancing rice productivity in Bangladesh, where nutrient deficiencies significantly limit yields. This study aimed to evaluate the combined effects of N and S fertilization on the growth, yield, and soil fertility of traditional *T. Aman* rice (BRRI Dhan 87). A field experiment was conducted during the 2019 *T. Aman* season at the Agronomy Field Laboratory, Sher-e-Bangla Agricultural University, Dhaka, following a randomized complete block design (RCBD) with 12 N-S fertilizer combinations and three replications. Results revealed that N and S significantly ($p<0.05$) influenced plant growth, yield attributes, and soil properties. The highest grain yield (5.67 t ha^{-1}) and straw yield (6.88 t ha^{-1}) were recorded under the $N_{120}S_{12}$ treatment, representing a 98.9% yield increase compared to the control (2.85 t ha^{-1}). The same treatment produced the tallest plants (131.78 cm), highest effective tillers (15.33 hill^{-1}), filled grains (140.37 panicle^{-1}), and 1000-grain weight (57.00 g). Post-harvest soil analysis showed improved organic matter (1.42%), total N (0.66%), and available P (27.03 ppm) under $N_{120}S_{12}$. The findings manifest that an integrated application of 120 kg N ha^{-1} and 12 kg S ha^{-1} optimizes yield performance and enhances soil fertility while minimizing resource losses. These results provide a sustainable nutrient management strategy for improving rice productivity in Bangladesh in similar agro-ecological zones.

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INTRODUCTION

Rice (*Oryza sativa* L.) is a staple food for over half of the global population, particularly in Asia, Africa, and Latin America (Fukagawa & Ziska, 2019). Rice is grown in more than a hundred countries with total cultivated area of about 160 million hectares and occupies 11% of the world's cultivated area with the production of more than 700 million tons (Mishra *et al*., 2022). In Bangladesh, rice cultivation is pivotal to the agricultural landscape, covering approximately 77% of the total cropped area. It serves as the primary staple food, contributing to about 72% of the daily caloric intake and 62% of the protein requirements of the population, underscoring its critical role in food security (Kuri *et al*, 2014). Bangladesh, the world's fourth-largest rice producer, faces significant challenges in sustaining yield growth to meet the demands of a rapidly growing population. The nation's agricultural land is virtually saturated, with limited capacity to expand food production. Climate change further exacerbates these challenges, leading to flooding and droughts that impact rice cultivation (Jamal *et al*., 2023). Nitrogen (N) is a key nutrient for rice production, and its efficient use is vital for achieving higher yields (Fu *et al.*, 2022). In rice production, farmers apply large amounts of nitrogen (N) fertilizer to maximize yield, but only 20–50% of N is taken up by the crop (Chivenge *et al.*, 2021).

The majority of N is lost through leaching, surface runoff, ammonia volatilization, and denitrification (Li *et al.*, 2022). To address this, urea super granules (USG) have been advocated as a superior alternative to prilled urea, as their deep placement in the root zone can increase NUE to 60% (Kamuruzzaman *et al.*, 2024). In addition to nitrogen, sulphur (S) deficiency has emerged as a major constraint for rice productivity in Bangladesh, affecting approximately 44% of the total cropped area (Bari *et al.*, 2023). Sulphur plays a crucial role in protein synthesis and chlorophyll formation, and its deficiency can severely limit crop growth (Zhou *et al.*, 2024). Approximately 3.1 million hectares of cultivable land in Bangladesh are affected by S deficiency, with an application rate of 8–12 kg/ha, attributed to factors such as intensive cropping, use of S-free fertilizers, depletion of organic matter, and high leaching losses in light-textured soils (Yesmin *et al.*, 2021). Studies have shown that S fertilization enhances the release of S from organic matter, expressing the importance of integrated nutrient management (Meena *et al.*, 2022). Retaining crop residues, particularly rice straw, can also mitigate S deficiency by recycling nutrients back into the soil (Devkota *et al.*, 2022). Despite the availability of high-yielding varieties, rice productivity in Bangladesh is constrained by the prevalent practice of imbalanced fertilizer use, particularly the inadequate application of sulfur and zinc, alongside the increasing pressures of soil degradation and climate variability (Islam *et al.*, 2022a, b).

The significance of the present research lies in optimizing nitrogen and sulphur fertilizer to enhance rice yield and soil fertility simultaneously, addressing both economic and environmental sustainability (Islam *et al.*, 2023; Kamuruzzaman *et al.*, 2024). However, a research gap was observed in the recent experiments- although nitrogen management and sulphur application have been studied individually, but their combined effect on T. *Amon* rice in subtropical Bangladesh including post-harvest soil nutrient status are scarce. This study aims to fill that gap by assessing multiple N-S rate combinations on the growth, yield attributes, grain and straw yields, and soil fertilizer, thereby delivering a novel insight into integrated nutrient management for T. *Aman* rice.

MATERIALS AND METHODS

Experimental site and design

The study was conducted at the Agronomy Field Laboratory, Sher-e-Bangla Agricultural University (SAU), Dhaka, Bangladesh (22.26°N, 90.22°E; 1.5 m above sea level) during the *T. Aman* rice-growing season (July–December 2019). The experimental site featured a subtropical climate with high rainfall (April–September) and moderate temperatures. The soil was clay loam (Madhupur Tract, AEZ 28), classified as non-saline coastal soil. Pre-experiment soil analysis (0–15 cm depth) revealed pH 6.2, 1.2% organic carbon, 0.08% total nitrogen, 12 mg kg^{-1} available phosphorus, and 8 mg kg^{-1} sulphur.

Treatments and experimental layout

A randomized complete block design (RCBD) with three replications was employed to evaluate twelve nitrogen (N) and sulphur (S) fertilizer combinations:

- T1: Control (0 kg N ha^{-1}, 0 kg S ha^{-1})
- T2: $N_{60}S_{12}$ (60 kg N ha^{-1}, 12 kg S ha^{-1})
- T3: $N_{120}S_{16}$ (120 kg N ha^{-1}, 16 kg S ha^{-1})
- T4: $N_{90}S_0$ (90 kg N ha^{-1}, 0 kg S ha^{-1})
- T5: N_0S_{12} (0 kg N ha^{-1}, 12 kg S ha^{-1})
- T6: $N_{60}S_0$ (60 kg N ha^{-1}, 0 kg S ha^{-1})
- T7: $N_{90}S_{16}$ (90 kg N ha^{-1}, 16 kg S ha^{-1})
- T8: $N_{120}S_0$ (120 kg N ha-^{1}, 0 kg S ha-^{1})
- T9: N_0S_{16} (0 kg N ha^{-1}, 16 kg S ha^{-1})
- T10: $N_{120}S_{12}$ (120 kg N ha^{-1}, 12 kg S ha^{-1})
- T11: $N_{60}S_{16}$ (60 kg N ha^{-1}, 16 kg S ha^{-1})
- T12: $N_{90}S_{12}$ (90 kg N ha^{-1}, 12 kg S ha^{-1})

Each plot measured 3 m × 2 m, with 50 cm spacing between plots and 1 m between blocks. In addition to the N and S treatments, a uniform basal dose of 15 kg phosphorus (P), 60 kg potassium (K), and 1.6 kg zinc (Zn) per hectare were applied to all plots to ensure balanced nutrient supply.

Crop management

Crop management practices for the experiment involved the use of BRRI Dhan 87, a high-yielding T. Aman rice variety sourced from the Bangladesh Rice Research Institute (BRRI). For seedling preparation, the seeds were soaked in water for 24 hours, incubated in darkness for 48 hours, and then sown in a wet nursery on 6 July 2019. After 25 days, the seedlings were transplanted on 1 August 2019 with a spacing of 25 cm × 15 cm, placing three seedlings per hill following land preparation using rotavator puddling and leveling. Fertilizer was applied in two stages: as a basal dose, triple superphosphate (TSP) at 80 kg P_2O_5 ha^{-1} and muriate of potash (MoP) at 90 kg K2O ha^{-1} were applied uniformly across the field. Nitrogen and sulfur were supplied using prilled urea (46% N) and gypsum (17% S), respectively, according to treatment design. Urea was applied in three splits 50% at transplanting, 25% at 20 days after transplanting (DAT), and the remaining 25% at 35 DAT. For irrigation, flood irrigation was maintained with an initial water depth of 3 cm, increased to 5 cm during the tillering stage, and completely drained 15 days before harvest. Weed control was carried out through manual weeding at 20, 35, and 50 DAT, while pest control included the application of Furanda 5G at 12 kg ha^{-1} and Malathion 100 SC at 1 L ha-^{1} to manage stem borers and leafhoppers.

Data collection

At maturity on 18 November 2019, yield attributes were recorded by sampling five hills per plot. Data collection included measurements of plant height and leaf length (both in centimeters), along with the number of tillers per hill, categorized into effective, non-effective, and total tillers. Additional observations included panicle length (cm) and the number of grains per panicle, distinguishing between filled and unfilled grains. Finally, the 1000-grain weight was measured in grams and adjusted to a standard moisture content of 14%.

Yield estimation: Grain and straw yields (t ha^{-1}) were measured from a 3 m^2 harvest area and adjusted using:

$$\text{Adjusted yield at 14\% moisture content} = \frac{100 - Mc}{86} \times W \; [100 - 14 = 86]$$

Here, Mc= Moisture content of grain; W= Fresh weight of grain.

Soil and plant analysis

Soil chemical properties were analyzed using standard laboratory methods. Soil pH was determined using a glass electrode pH meter following the method described by Jackson (1962). Organic carbon content was measured by the wet oxidation method as outlined by Walkley & Black (1934). Total nitrogen (N) was assessed through the Kjeldahl digestion-distillation method according to Jackson (1973). Available phosphorus (P) was measured spectrophotometrically at 660 nm using the ascorbic acid reduction method (Watanabe & Olsen, 1965). Finally, available sulfur (S) was determined using the turbidimetric method at 420 nm, following the procedure described by Tandon (1995).

Statistical analysis

Data were analyzed using ANOVA in MStat-C, with mean separation by Duncan's Multiple Range Test (DMRT) at p < 0.05.

RESULTS AND DISCUSSION

Effect of nitrogen and sulphur on the growth of T. *Aman* rice (BRRI Dhan 87)

Plant height: Nitrogen and sulphur fertilizer management significantly (p<0.05) affected plant height at harvest stages of rice plant (Figure 1). At harvest stage significantly tallest plants (131.78 cm) were recorded from T_{10}treatment ($N_{120}S_{12}$) and the shortest plant height at harvest stage (105.94 and 102.33 cm) was recorded from T_5 and T_1 ($N_0S_{12}$and Control) treatment, respectively.

Leaf length: In case of leaf length of rice, significant (p<0.05) difference was observed because of nitrogen and Sulphur fertilizer management at the harvest stage of rice (Figure 2). The highest leaf length at the harvest stage (34.94 cm) was recorded from treatment T_{10} ($N_{120}S_{12}$) followed by treatment T_3 ($N_{120}S_{16}$), T_4 ($N_{90}S_0$), T_7 ($N_{90}S_{16}$), T_8 ($N_{120}S_0$), T_{11} ($N_{60}S_{16}$) and T_{12} ($N_{90}S_{12}$) where the lowest leaf length (23.06 cm) was recorded from treatment T_1 (control). It was observed that the higher dose of nitrogen increases the leaf length. These findings are supported by recent studies. Kaysar *et al.* (2022) reported that increasing nitrogen up to optimal levels significantly enhanced both plant height and leaf length in rice, while balanced nutrient management further amplified these effects. Mustafa *et al.* (2022) demonstrated that sulfur application under sufficient nitrogen conditions improves nitrogen utilization, resulting in greater vegetative growth, including enhanced leaf development. The combined effects of high nitrogen and adequate sulfur thus explain the superior growth observed under T10 and other high-N treatments in the present study.

Effective tillers $hill^{-1}$: Nitrogen and sulphur fertilizer management significantly (p<0.05) affected the effective tillers hill per hill (Table 1). The highest number of effective tillers per hill (15.33) was recorded from treatment T_{10} ($N_{120}S_{12}$) followed by treatment T_3 ($N_{120}S_{16}$) and the lowest number of effective tillers per hill (10.00) was recorded from treatment T_1 (control) followed by T_5 (N_0S_{12}), T_6 ($N_{60}S_0$) and T_7 ($N_{90}S_{16}$). Present experiments showed that higher doses of nitrogen produce maximum number of effective tillers per hill.

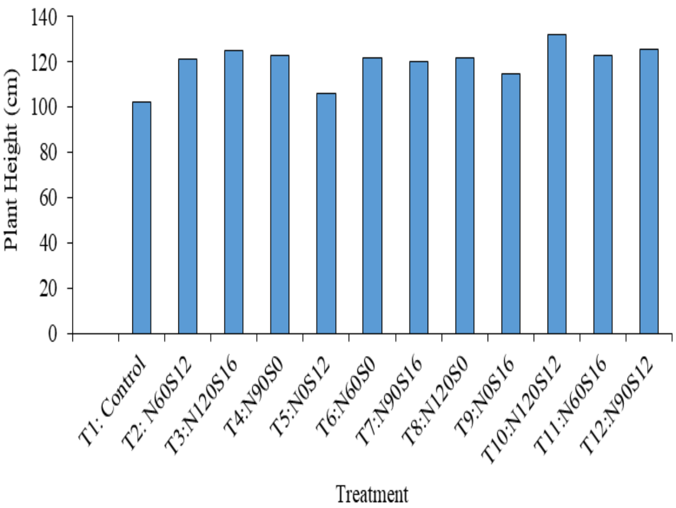

Figure 1. *Effect of nitrogen and sulphur on plant height of T. Amon rice (BRRI Dhan-87).*

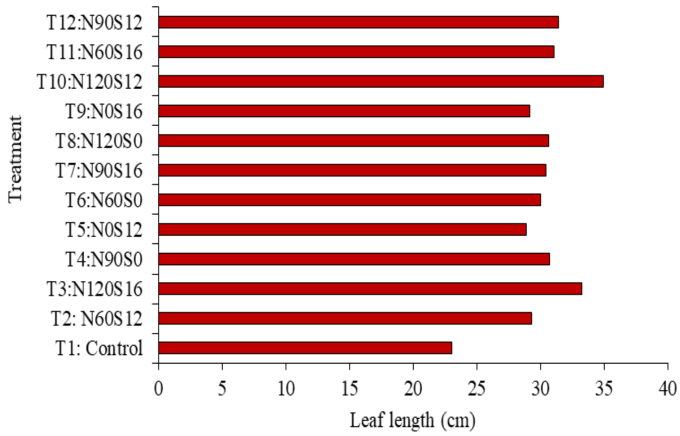

Figure 2. *Effect of nitrogen and sulphur on leaf length of T. Amon rice (BRRI Dhan-87).*

Table 1. Effect of nitrogen and sulphur on plant height of T. *Amon* rice (BRRI Dhan-87).

Treatment	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Total tillers hill^{-1} (no.)
T_1	10.00 e	0.99	10.99 e
T_2	12.78 bcd	1.78	14.56 abc
T_3	14.45 ab	0.887	15.33 ab
T_4	12.00 cde	0.777	12.78 cde
T_5	11.33 de	0.877	12.21 de
T_6	11.11 de	1.333	12.44 cde
T_7	11.44 de	1.000	12.44 cde
T_8	14.11 abc	1.110	15.22 ab
T_9	12.00 ade	1.000	13.00 cde
T_{10}	15.33 a	1.003	16.34a
T_{11}	12.55 bcd	0.847	13.40 bcd
T_{12}	13.33 abcd	2.110	15.44 ab
CV (%)	9.93	7.06	8.66
Level of significant	*	NS	*
SE (±)	1.02	0.439	0.967

Means in a column followed by the same letter (s) do not differ significantly analyzed by DMRT. NS= Non-significant, *= Significant at 5% level of probability, CV = coefficient of variance, NS = Non-significant and SE= Standard error.

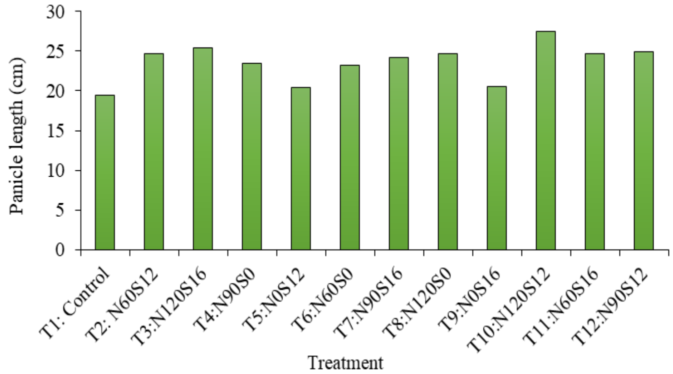

Figure 3. *Effect of nitrogen and sulphur on panicle length of T. Amon rice (BRRI Dhan-87).*

Non-effective tillers hill^{-1}: No significant ($p>0.05$) difference was found in case of non-effective tiller per hill of rice due to effect of nitrogen and Sulphur fertilizer management (Table 1).

Total tillers hill^{-1}: Significant ($p<0.05$) difference was observed in case of total tillers per hill due to effect of nitrogen and sulphur fertilizer management (Table 1). The highest number of total tillers per hill (16.34) was recorded from treatment T_{10} ($N_{120}S_{12}$) followed by treatment T_3 ($N_{120}S_{16}$), T_8 ($N_{120}S_0$) and T_{12} ($N_{90}S_{12}$) where the lowest number of total tillers per hill (10.99) was recorded from treatment T_1 (control) followed by T_5 (N_0S_{12}). These findings align with recent studies. For instance, Zhang *et al.* (2023) observed that sulfur application increased the number of tillers per hill in rice, particularly when combined with optimal nitrogen levels. Similarly, Rashid *et al.* (2025) reported that nitrogen application significantly increased tiller numbers in rice, which highly expresses the importance of nitrogen in tillering.

Panicle length (cm): Nitrogen and sulphur fertilizer management significantly ($p<0.05$) affected the panicle length of rice. The highest panicle length (27.52 and 25.40 cm) was recorded from treatment T_{10} ($N_{120}S_{16}$) and T_3 ($N_{120}S_{16}$), respectively followed by treatment T_2 ($N_{60}S_{12}$), T_8($N_{120}S_0$), T_{11}($N_{60}S_{16}$) and T_{12} ($N_{90}S_{12}$) where the lowest panicle length (19.44 cm) was recorded from T_1 (control) followed by treatment T_5 (N_0S_{12}) and T_9 (N_0S_{16}). It was observed that the highest panicle length was recorded from those treatments which contain higher doses of nitrogen (Figure 3). These findings align with recent studies. For instance, Zhang *et al.* (2023) reported that increasing nitrogen application up to optimal levels significantly increased panicle length and overall vegetative growth in rice. Similarly, Khampuang *et al.* (2023) and Fu *et al.* (2023) demonstrated that sulfur application improved nitrogen use efficiency, leading to enhanced panicle length and overall growth in rice.

Filled grain panicle^{-1}: Number of filled grains per panicle of T. *Aman* rice (BRRI Dhan-87) showed significant difference ($p<0.05$) due to the effect of nitrogen and sulphur fertilizer management (Table 2). The highest number of fill grain per panicle (140.37) was recorded from treatment T_{10} ($N_{120}S_{12}$) and the lowest number of fill grain per panicle (68.29) was recorded from treatment T_1 (control).

Unfilled grain panicle^{-1}: In case of unfilled grain per panicle of T. *Aman* rice (BRRI Dhan-87) significant ($p<0.05$) difference was found due to the effect of nitrogen and sulphur fertilizer management (Table 2). The highest number of unfilled grains per panicle (24.15) was recorded from treatment T_1 (control) followed by all other treatments except treatment T_{11} ($N_{60}S_{16}$) and T_{12} ($N_{90}S_{12}$) where the lowest number of unfilled grains per panicle (19.26) was recorded from treatment T_{11} ($N_{60}S_{16}$) followed by treatment T_{12} ($N_{90}S_{12}$).

Total grain panicle^{-1}: Total grain per panicle of T. *Aman* rice (BRRI Dhan-87) also showed significant ($p<0.05$) difference because of nitrogen and sulphur fertilizer management (Table 2). The highest number of total grains per panicle (156.44) was counted from treatment T_{10} ($N_{120}S_{12}$) where the lowest number of total grains per panicle (92.44) was recorded from treatment T_1 (control). These findings, align with recent studies, highlight the positive impact of balanced nitrogen and sulphur fertilization on rice yield components. For instance, a study by Wang *et al.* (2021) reported that the application of nitrogen fertilizer significantly influenced grain storage protein synthesis, thereby affecting grain yield and quality.

Table 2. Effect of nitrogen and sulphur on fill grain per panicle, unfill grain per panicle total grain per panicle of T. *Aman* rice (BRRI Dhan-87).

Treatment	Fill Grain panicle^{-1} (no)	Unfilled grain panicle^{-1} (no)	Total grain panicle^{-1} (no)
T_1	68.29f	24.15a	92.44g
T_2	104.67de	21.92ab	126.59ef
T_3	122.66bc	22.52ab	145.18b
T_4	115.11c	23.59ab	138.70bc
T_5	98.41e	22.37ab	120.78f
T_6	106.85d	22.18ab	129.03de
T_7	123.44b	22.44ab	145.89b
T_8	122.33bc	21.14ab	143.47bc
T_9	117.59bc	20.89ab	138.48bc
T_{10}	140.37a	16.07ab	156.44a
T_{11}	116.74bc	19.26c	136.00cd
T_{12}	117.63bc	20.52bc	138.15bc
CV (%)	3.75	10.71	3.23
Level of significant	**	*	**
SE (±)	3.46	1.87	3.54

Means in a column followed by the same letter (s) do not differ significantly analyzed by DMRT. NS= Non-significant, *= Significant at 5% level of probability, **= Significant at 1% level of probability, CV = coefficient of variance, and SE= Standard error.

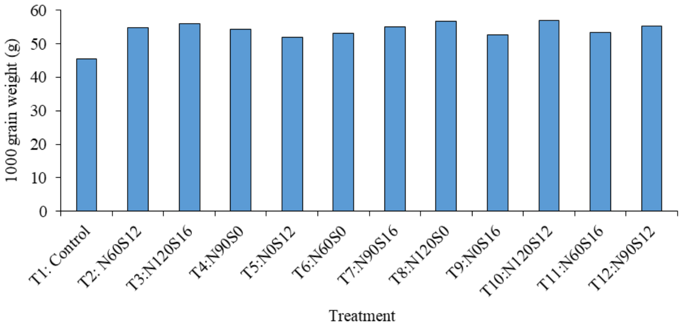

Figure 4. *Effect of nitrogen and sulphur on 1000 grain weight of T. Amon rice (BRRI Dhan 87).*

1000 grain weight (g): 1000 grain weight of T. *Aman* rice (BRRI Dhan-87) showed significant difference because of nitrogen and sulphur fertilizer management (Figure 4). The highest 1000 seed weight of T. *Aman* rice (BRRI Dhan-87) (57.00g) was recorded from treatment T_{10} ($N_{120}S_{12}$) followed by treatment T_8 ($N_{120}S_0$) where the lowest 1000 seed weight of T. *Aman* rice (BRRI Dhan-87) (45.50 g) was recorded from treatment T_1 (control). Moniruzzaman *et al.* (2022) found that increasing nitrogen rates up to about 100-110 kg N/ha (with recommended P, K, and Sulfur also applied) significantly increased grain yield, straw yield, and the 1000-grain weight of BRRI dhan29 rice on floodplain soils in Bangladesh. Das *et al.* (2024) revealed that combined application of poultry manure and full recommended fertilizer (including S) significantly increased not only yield and many agronomic traits, but also 1000-grain weight.

Grain yield: In case of grain yield of T. *Aman* rice (BRRI Dhan-87) significant ($p<0.05$) difference was observed due to the effect of nitrogen and sulphur fertilizer management (Figure 5). The highest grain yield (5.67 t/ha) was recorded from T_{10} ($N_{120}S_{12}$) where the lowest grain yield (2.85 t/ha) was recorded from treatment T_1 (control). Kaysar *et al.* (2022) stated that optimum N application enhanced root traits and grain yield in rice under subtropical conditions, supporting the positive role of balanced nutrient supply in achieving higher yields.

Straw yield: Significant ($p<0.05$) differences are also found in case of straw yield of T. *Aman* rice (BRRI Dhan-87) due to the effect of nitrogen and sulphur fertilizer management (Figure 6). The highest grain yield (6.88 t/ha) was recorded from T_{10} ($N_{120}S_{12}$) where the lowest grain yield (3.75 t/ha) was recorded from treatment T_1 (control). Moniruzzaman *et al.* (2022) noted that increasing N fertilizer rates significantly enhanced straw yield of Boro rice in Bangladesh, confirming the importance of adequate N supply for vegetative biomass production.

Effect of nitrogen and sulphur on the pH, OM, N (%), P (ppm) and S (ppm) in post-harvest soil of T. *Aman* rice

No significant ($p>0.05$) difference was observed in the effect of nitrogen and sulphur on the pH of post-harvest soil in T. Aman rice (Table 3). Effect of nitrogen and sulphur on the organic matter content in post-harvest soil of T. *Aman* rice showed significant difference. The highest amount of organic matter content of the soil (1.42) was recorded from the plot treated with treatment T_{10} ($N_{120}S_{12}$) followed by treatment T_3 ($N_{120}S_{16}$) where the lowest organic matter content of the soil (0.91) was recorded from the plot treated with treatment T_1 (control). Total N content in the post-harvest soil of T. *Aman* rice showed significant difference due to the effect of nitrogen and sulphur fertilizer management (Table 3). The highest total N content of the soil (0.66%) was recorded from the plot treated with treatment T_{10} ($N_{120}S_{12}$) followed by treatment T_3 ($N_{120}S_{16}$) where the lowest total N content of the soil (0.46%) was recorded from the plot treated with treatment T_1 (control). Available P content in the post-harvest soil of T. *Aman* rice showed significant difference because of nitrogen and sulphur fertilizer management. The highest available P content of the soil (27.03 ppm) was recorded from the plot treated with treatment T_{10} ($N_{120}S_{12}$) followed by treatment T_3 ($N_{120}S_{16}$) where the lowest available P content of the soil (16.96 ppm) was recorded from the plot treated with treatment T_1 (control). Non-significant difference was found in case of effect of nitrogen and sulphur on the available S in post-harvest soil of T. *Aman* rice (Table 3). Similar improvements in soil fertility parameters with integrated nutrient management have been reported by Rashid *et al.* (2025), who observed enhanced

Table 3. Effect of nitrogen and sulphur on pH, OM, N (%), P (ppm) and S (ppm) in post-harvest soil of T. *Aman* rice.

Treatment	pH	Organic matter	Total N (%)	Available P (ppm)	Available S (ppm)
T_1	5.63	0.91d	0.46 d	16.96 d	11.73
T_2	6.10	1.29abc	0.58 abc	18.31 cd	13.58
T_3	6.37	1.36ab	0.62 ab	26.04 ab	15.36
T_4	6.23	1.31abc	0.59 abc	23.71 abc	14.72
T_5	6.27	1.15 c	0.52 cd	21.17 bcd	13.23
T_6	6.33	1.24abc	0.56 bc	22.20 abcd	13.82
T_7	6.20	1.31 abc	0.58 abc	23.56abc	14.42
T_8	6.30	1.29 abc	0.61 abc	23.16 abc	16.25
T_9	6.53	1.17bc	0.53bcd	21.48bcd	14.17
T_{10}	6.30	1.42 a	0.66 a	27.03 a	16.15
T_{11}	6.40	1.30 abc	0.55 bcd	23.88 abc	14.35
T_{12}	6.34	1.28 abc	0.59 abc	23.42 abc	14.07
CV (%)	6.39	5.62	5.61	8.76	8.66
Level of significant	NS	**	**	**	NS
SE (±)	0.3261	0.0575	0.0262	1.61	1.00

Means in a column followed by the same letter (s) do not differ significantly analyzed by DMRT. NS= Non-significant, **= Significant at 1% level of probability, CV = coefficient of variance, NS = Non-significant and SE= Standard error.

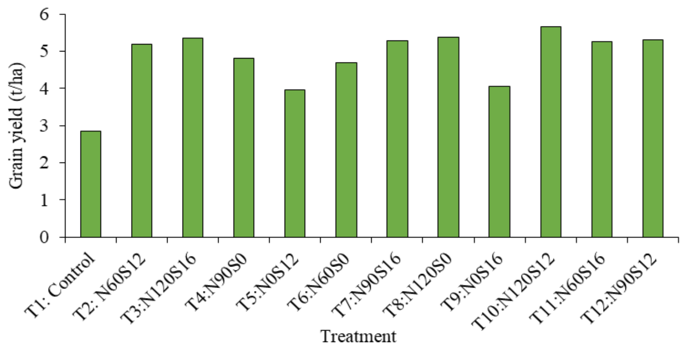

Figure 5. *Effect of nitrogen and sulphur on grain yield of T. Amon rice (BRRI Dhan-87).*

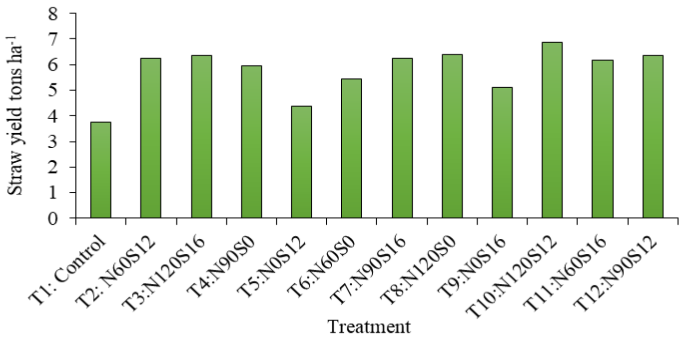

Figure 6. *Effect of nitrogen and sulphur on straw yield of T. Amon rice (BRRI Dhan 87).*

post-harvest soil N and organic matter in rice-based systems. Moniruzzaman *et al.* (2022) also found that higher N application I ncreased soil fertility indices in rice fields, supporting the present findings.

Conclusion

In conclusion, nitrogen and sulphur fertilization significantly ($p<0.05$) enhanced the growth, yield, and soil nutrient status of T. *Aman* rice (BRRI Dhan 87). The $N_{120}S_{12}$ treatment (120 kg N + 12 kg S ha^{-1}) proved most effective, yielding the highest plant growth metrics, yield components, and post-harvest soil fertility compared to other treatments. In contrast, the control treatment produced the lowest performance across all parameters. These results predominantly indicate the importance of balanced N and S management in maximizing rice productivity and sustaining soil health. Further research should explore the long-term impacts, economic feasibility, and environmental implications of this fertilization strategy across diverse rice-growing regions.

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